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LITTLE-KNOWN FACTS ON A WELL-KNOWN PLANT

THE most popular houseplant ever grown in America is probably the heartleaf philodendron. Its popularity is doubtlessly due to the ability of this species to grow satisfactorily away from the window in almost any position where the plant is needed for its decorative value. With the shift to simplicity in design of the modern home, plants were shifted from the window garden and became a necessary supplement to good interior décor. This change brought about a search for new kinds of plants that would withstand the adverse growing conditions of the home while furnishing the desired decorative effects. It led to the introduction of many kinds of plants previously unfamiliar to the homemaker, such as bromeliads and new aroids[1]—plants whose beauty is their handsome foliage or interesting form rather than their flowers. Of all the plants used for their foliage alone, the aroids provide the greatest number of species for interior use.

There are at least two hundred different kinds of *Philodendron*, native from central Mexico and the West Indies to southermost Brazil and Uruguay. The name of this group of plants comes from two Greek words meaning "tree-loving." It is an appropriate name, since many species of *Philodendron* have elongate stems that climb the tree trunks by means of aerial roots that grow at each joint of the stem. Often these vines grow high into the trees, and have contact with the soil only through their aerial roots which grow down and finally enter the soil. Such roots are very tough, and are an important cordage material in some tropical American regions. In other species, however, the stems are very short, and the plants appear nearly stemless, as in *P. wendlandii*. Such species grow in the forks of trees or upon rocks. Still other kinds develop a trunk and appear tree-like in age, like *P. selloum*.

The common heartleaf philodendron belongs to the group with elongate stems with aerial roots for climbing. For years, this species has been offered on the market under the name of *P.* "cordatum". It is well established that the plant originally described under this name is altogether different from our heartleaf philodendron. The proper name of this latter plant appears to be *P. oxycardium*, although there is some question about it. Until further detailed studies can be carried out, we may speak of this plant as *P. oxycardium*. In its original description the author (A. Schott) made no

[1] Aroids include philodendron, dieffenbachia, chinese evergreen, the calla (-lily), and the native jack-in-the-pulpit.

mention of the material from which he drew his description, but in a publication four years later, he noted that the plant was seen growing in cultivation. It is typical that many of the philodendrons and other plants introduced into the gardens of Europe in the nineteenth century were unknown botanically. And indeed, there are undescribed species growing in our botanical gardens today! It is as if the plantsman always has the lead over the botanist, and despite the long and arduous journies of botanists into the wilds to collect the flora of any particular region, the traveling plantsman will bring back and grow specimens of species unknown to science! Schott found the heartleaf philodendron growing in cultivation before 1854, so he described it as a new species. By 1879, many specimens of this species collected from the wild had accumulated in the botanical museums of Europe, and indicated that *P. oxycardium* occurs natively in the West Indies, Central America, and in northern South America. Subsequent collections show that this species occurs also in Mexico.

In nature, most philodendrons inhabit areas of high rainfall where the soil remains moist even in the dry season. The temperature never falls much below 65°, and constant high atmospheric humidity exists. Philodendrons are most common in lowland rainforest areas where they form a conspicuous element in the forest flora.

According to the plant records of the Missouri Botanical Garden, cuttings of the heartleaf philodendron were among the "plants received from Mr. Fendler from South America[2] about 1869 and later". These records, however, were written in 1898, and possibly were copied from the original notes of Henry Shaw. August Fendler was a first-rate naturalist, and collected plants in southwestern United States as well as in tropical America. He spent four months of 1849 in Panama collecting at and above the mouth of the Río Chagres, an area on the Atlantic side of the present-day Canal Zone. In 1859, Fendler went to Venezuela where he spent four years in the study of the flora and meterological phenomena. He prepared many fine botanical specimens, collected especially in the region around Colonia Tovar, a settlement at 6500 feet altitude where he owned a small farm. He finally returned to the tropics and settled in a suburb of Port-of-Spain, Trinidad, in 1877. where he died in 1885. The specimen of heartleaf philodendron that he sent to Shaw's Garden may well have come from any of these places, but the date "1869 and later" would suggest that it came from Trinidad. When the species growing at this Garden is compared with specimens collected in Venezuela, Trinidad, and Panama, we may have a more accurate idea of the origin of Fendler's plant. Irrespective of its origin, there are plants derived from that introduction still growing luxuriantly on the central wall of the northwest wing of the Floral Display House. They are the best examples of the mature phase of this species known

[2] In Bull. Missouri Bot. Gard. 43(7):105. 1955, L. Cutak erroneously reported their origin as Brazil.

to me. The stems climb about thirty feet to the roof, and the hanging tips often grow down again nearly to the ground. Their diameter equals or exceeds that of a fountain pen. The larger leaves average about 13–14 inches long and about 9 inches wide. Unless heavily pruned, many blossoms are produced in June of each year. Upon first hearing this, many people ask: "You mean philodendrons have flowers?" With rare exceptions, all seed plants have flowers at some time during their life. Otherwise no seeds would be produced, and no new plants would grow. That philodendrons do not flower in our homes signifies lack of proper environmental conditions. But under ideal conditions of growth —conditions similar to those of the forest where the plants grow natively, flowering will occur periodically. A few species produce flowers almost constantly.

Flowering of the heartleaf philodendron appears to be initiated when the days and nights are of nearly equal length, as in the tropical latitudes. At the latitude of St. Louis, this happens about March 21 and again on September 21, but the plants do not respond to the September season. After initiation, many weeks are required for the blossoms to develop, and the first inflorescences open at the end of May. The inflorescence pictured on the cover is typical for philodendrons. It consists of a thick, leaf-like structure (the spathe) that is green or variously colored, wrapped around and enveloping a column covered with many very small flowers (the spadix). The spadix has the pistillate (female) flowers covering the lower part, and the upper part is covered with staminate (male) flowers. Both sorts of flowers are so modified as to scarcely resemble flowers in the usual sense, but they possess the necessary structures for reproduction—namely, pistil and stamens.

The inflorescence of the heartleaf philodendron is about six inches long. The spathe is nearly cylindric, on the outside light green in the lower half, the upper part creamy-yellowish. The inside of the spathe is creamy except near the base where it becomes a rich cherry red. It is interesting that the only color on this elaborate blossom should be hidden deep inside away from the eyes of nature. The spadix is as long as the spathe, and its lower third is covered with female flowers. The upper part is covered with staminate flowers that exude droplets of sticky amber liquid, and it has a mild pungent fragrance, as does the cut tissue.

The flowers are exposed to the elements for a very brief period (about one day) when the upper half of the spathe unrolls to expose the staminate part of the spathe. At this time, the pistillate flowers are probably receptive to pollen, but the exposed male flowers are not yet producing ripe pollen. The spathe soon closes again very tightly around the spadix, after which the pollen is shed. How pollination is accomplished in indeed a puzzle requiring further observation and study. No doubt, there are specific insects involved in the pollination of certain species. Their absence here may explain the lack of seed production in the plants at the botanical garden.

It appears that the Missouri Botanical Garden "has furnished the stock which made the Heartleaf Philodendron the universal houseplant that it is today."[3] Mr. George H. Pring, Superintendent of the Garden, states that "cuttings from this vine were given to Bourdet Floral Company [of St. Louis] for trial as a possible commercial plant some 43 years ago."[3] The small-leaf trailing plants of *P.* "cordatum" so familiar to us in the home are simply juvenile specimens which, if grown again in an ideal environment, would attain the proportions of the mature plants described above. As long as a plant is kept in the home, the low moisture content of the air and the low light intensity, especially of winter, will prevent it from reaching the luxuriant form of which it is capable. But the small-leaf form has become the standard, so as long as your plants have decorative value, you need not worry about the size of the leaves.

—GEORGE S. BUNTING

[3] Cutak, L. Bull. Missouri Bot. Gard. 43 (7):105. 1955.

(Photo by Kenneth Peck)

REPORT ON THE NEW GREENHOUSE CONSTRUCTION IN THE MISSOURI BOTANICAL GARDEN

In the beginning of June our large Palm House and the adjoining Economic and Fern Houses were demolished to make room for the new Climatron, a greenhouse of strictly-modern design, which is to take their place this autumn.

The old Palm House and ajoining houses were built in 1913, and had been among the most outstanding features of the Missouri Botanical Garden. The stately greenhouses, with their white columns in front, formed a beautiful background for the water lily pools for any visitors entering the Main Gate. However, in the course of time, the steel structure had deteriorated and was badly rusted in many places. To repair these houses would have been almost prohibitively expensive. Another disadvantage of these old houses was that they allowed the entry of only a small fraction of the total amount of daylight which, especially during winter, slowed the growth of the greenhouse plants to a very large extent.

Any modern greenhouse should be air-conditioned, especially in climates where the summer temperatures get very high, such as in most of the continental United States. The original greenhouse was intended to grow tropical plants in a cool or cold climate, such as England, Holland or Sweden. It was necessary only to heat the houses, which could be done by conventional methods. However, in areas where summer temperatures are very high, the inside of the greenhouse gets still warmer, and the growing conditions for most plants become very poor. Therefore, in climates like St. Louis, we need greenhouses which can be heated during winter and at night, and which can be cooled during day. This can only be done with air-conditioning. Thus, to have really effective greenhouses in St. Louis, they should be air-conditioned.

Air-conditioning actually means the controlling of temperature, by introducing air at the desired temperature. Thus the air must be cooled or heated *before* it is introduced into the greenhouse. For a tropical greenhouse, such as the Climatron will be, it is necessary to cool the air only to a limited degree, which can be done by evaporative cooling. To this end, air is passed through a spray of water. To evaporate water, a large amount of heat must be supplied. As the water evaporates in the air, it removes heat from the air, which is thereby cooled. This cooled air is then pulled through the Climatron by a battery of twenty large fans which distribute the air evenly through the house.

The heating is accomplished in a somewhat similar manner. Instead of having heating coils all through the greenhouse, air is heated in an underground tunnel and is then injected along one side of the Climatron. It is pulled out again on the other side and

returned to the heater. In this way a continuous circulation of heated air goes through the house, keeping it at the desired temperature. A special advantage of this method of heating is that it does not, in the least, interfere with the growing of the plants, nor does it produce pockets of hot air near the steam pipes.

The concrete base for the Climatron is at present (August 1st) being poured, and the aluminum superstructure will soon be erected.

Most of the palms of the old Palm House have been saved by very carefully removing the old Palm House structure from around the existing palms, which are now standing free in the Garden. To see a palm grove standing free in the middle of St. Louis is indeed a remarkable sight, and one which will probably never recur in this City.

In the meantime, Mr. Lad Cutak and Mr. Ed Evinger are propagating plants for filling the Climatron after it has been completed. But it will be many years before the planned replicas of tropical forests will be mature, and will completely fill the Climatron.

As if to make up for the temporary scars of the construction program, the water lilies in the pools just beyond the main gate are at their best and are, if possible, more beautiful than ever.

—F. W. WENT

PLANTING IN THE CLIMATRON

THE Garden is constructing an all new air-conditioned conservatory known as a "Climatron" described elsewhere in this Bulletin. Our Director, Dr. Fritz W. Went, anticipating the day when this would be ready, collected seeds of many of the choice plants he saw growing in the tropical regions of South America while on his trip during the past winter. The Experimental Greenhouse has become a beehive of activity. These seeds, with others received from tropical regions, have been planted and are now growing in profusion, along with many plants and propagating material salvaged from the old palm house. While it is not possible at this time to predict just how many and exactly what kinds of tropical plants we will need for the new "Climatron" we will have on hand a wealth of selected material to give the new display a truly "equatorial" look.

A great majority of visitors will never have the opportunity of visiting and seeing the tropical areas personally. For this reason the space within the great dome will be designed and arranged to simulate three of the general classes of tropical climes: (1) the Panamanian rain forest, (2) the East Indian tropics and (3) an Hawaiian garden. The Panamanian rain forest will be in a warm moist area accomplished by the use of fog mists and a water curtain. Rice paddies, unknown to most Americans, will be the focal point of the East Indian tropical area. Hawaii, for centuries considered a

paradise of riotous beauty, will be represented by a garden breath-takingly colorful with such flowers and trees as pink and golden shower trees *(Cassia sp.)*, poincianas *(Delonix regia)* and the tropical hibiscus *(Hibiscus rosa-sinensis)* in its many varieties.

Such economic crops as coffee, bananas, pineapples, tea and cashew nuts will be grown to satisfy curiosity and add to the knowledge of viewers. Mosses, ferns and hundreds of smaller plants will carpet the ground as they do in their native environment.

Tangles of tropical vines, such as philodendrons, monsteras, alamandas, clerodendrons, will climb about in profusion, while orchids, anthuriums, bromeliads and other epiphytes will add their prismatic glory.

The palms will, as they always have, dominate the entire scene. It is hoped that the best of the present trees will survive the ordeal of construction over and around them and return to their former grandeur.

In this age of the atom, jets and flights into outer space, the guiding minds at Missouri Botanical Garden have seen and met the need to bring to the people a haven of beauty, peace and wonder. St. Louisans can well be proud of this new addition to their city.

—EDGAR L. EVINGER

WHAT'S IN A NAME?

By GEORGE S. BUNTING

MISS Gertrude Stein once wrote: "A rose is a rose is a rose." The essence of this thought is clear, but any true gardener must contest her statement when he starts to plant his garden. Most of us are familiar with the "living fence" rose *(Rosa multiflora)* so widely offered for sale in this country. We know that this rose has no place in the average home garden. Furthermore, we know that the hybrid tea roses offer excellent varieties for the rose garden, while certain species of roses, like *Rosa hugonis*, are lovely shrubs suited for specimen planting.

Imagine trying to landscape our home gardens without knowing the names of at least some plants. There are thousands of species of plants and additional thousands of varieties of these species in cultivation. Our ability to select the correct ones is nowhere better exemplified than in planting our own gardens. To do this we must know something about the many different kinds of plants, and to really know a plant, we must have a name for it. Otherwise, how can we talk about it to others, and read what others have written about its culture and merits

No doubt you like to grow irises in your garden. If you open a catalog to make a selection, you find that

there are German bearded irises, Siberian irises, Japanese and Dutch irises, all in many varieties and colors, plus *Iris cristata, I. pumila,* and dozens of others. Many sorts have no common English names, so we must refer to them by their scientific names, which are in Latin.

The Latin name of a plant is suggestive of the name of a person. It consists of two parts corresponding to the last and first name of a person, arranged in that order. Often one of these is familiar to us, as in *Forsythia intermedia, Camellia japonica, Dahlia pinnata, Narcissus pseudonarcissus,* while others like *Pinus, Rosa* and *Juniperus* are familiar in their slightly changed English versions. But many of the Latin names of plants are unfamiliar to us; a name such as *Euonymus Bungeanus* may easily seem to be the name of some ancient citizen of Rome rather than that of some commonly cultivated tree.

Many persons have difficulty with these names, and with good cause. But this is no reason to ignore them. It is better to become familiar with them, understand their origins, the reasons why a plant bears the name it does. Often the name commemorates some person who was in some way connected with botany or the plant concerned; the name of the bird-of-paradise flower, *Strelitzia reginae,* which was described in 1789, honors Queen Charlotte Sophia of the House of Mecklenburg-Strelitz, wife of George III of England. Other names are imaginatively descriptive, like *Iris,* which means "rainbow" in Greek. The cocoanut palm bears the Latin name *Cocos nucifera.* The coconut, when stripped of its husk, suggests the face of a monkey. "Cocos" is the word for "monkey" in Portuguese. Some names are really quite comical when their origins are known. Most of us are familiar with the common weed called the day-flower *(Commelina communis).* The flowers of *Commelina* have two showy blue petals and one inconspicuous one. Linnaeus named this genus for the Dutch brothers Commelin; two of these brothers were botanists of the late seventeenth century, while the third died before accomplishing anything botanical! Still other Latin names are based upon the native name of a plant. The aboriginal American word "batata" forms part of the name for the sweet potato, *Ipomoea batatas,* and is the root of the English word "potato."

The reasons for the usage of the Latin names of plants is easy to explain. There is only one correct Latin name for a plant, and it is standard around the world. Therefore, whether you read French, Russian, or Japanese, the Latin name of a plant always looks the same, and it is always written in the Roman alphabet. It does not change from country to country. You may wish to buy seeds of a fancy Swiss variety of pansies. The catalog may be written in German or French, and the common name of the pansy listed as Stiefmütterchen or pensée, but the proper name for it remains *Viola tricolor* var. *hortensis.* Only the fancy variety names may look strange, and probably many of them will be familiar to the true plantsman.

A second reason for using the Latin

names of plants is for clarity within our own language. We often speak of cedar trees. The word "cedar" is applied to no less than five different plants, all well-known in certain areas or industries. When someone mentions cedar to me, I think first of the red cedar *(Juniperus virginiana)* that grows along the fence rows in the fields in my native Maryland, and which yields that wonderful, scented wood used to make cedar chests and to line closets. But then I stop and wonder: "Maybe the person was talking about the white cedar," a name often applied to *Chamaecyparis thyoides,* as well as to the arbor vitae *(Thuja occidentalis)*. As if the confusion were not already sufficient, the cedar in question could be the true cedar *(Cedrus libani)*, the Cedar of Lebanon, or it might be the Spanish cedar, *Cedrela odorata,* sometimes called the cigar-box cedar. For the sake of clarity, it is often imperative to use the proper (Latin) name of a plant.

It is important to understand why these proper names are in Latin. Why not Greek, or Arabic, or some other difficult tongue? A brief glance at history explains this. After the spread of Christianity, and the fall of the Roman Empire, the monasteries were citadels of academic knowledge and scholarly achievement, and remained so throughout the Dark Ages in Europe until the universities were established. Latin was the language of the Roman Church then even as it is today. The Bible and other writings not originally written in Latin had been translated and laboriously copied in Latin. Books used in the early universities were, therefore, copies of the Latin manuscripts preserved in the monasteries. Hence, Latin was established as the academic language, and since it was the only static one, served as the universal language of the scholars just as it had for the Church. The precedent thus established, Latin persisted as an academic language, and indeed knowledge of it is still a requisite for entrance to the great English university of Oxford, and others in Europe.

About two hundred years ago, a Swedish physician named Carl von Linné originated the idea of giving each species of plant and animal two names. This system is suggestive of our family system of naming, whereby all members of one immediate family have the same surname, and each individual has one or more given (Christian) names. In the case of animals and plants, the name of the genus is equivalent to the surname, and is followed by the name of the species: for example, the proper name of the tiger is *Felis tigris,* and of the lion, *Felis leo;* the American elm is *Ulmus americana,* the Chinese elm, *Ulmus chinensis,* the slippery elm, *Ulmus fulva.*

At the time Linné wrote his great works, (1736–1763), many of the animals and plants of Europe and western Asia were known to science, as well as those of eastern North America and the West Indies, and of coastal South America, Africa, and Australia. The number of known species was already great, and Linné doubtlessly realized that many more species would be encountered as new

areas were explored. Before his time, writers had referred to a species by giving the generic name followed by a short description usually of not more than four or five words, for example: *Colocasia hederacea sterilis minor, folio cordato.* This system was clumsy, and very difficult to use when speaking about the various species, especially since these descriptions were in Latin. The binomial system invented by Linné permitted easy mention of any species. Since his native tongue, Swedish, was scarcely known in foreign countries, he wrote his works in Latin, which was still the academic language universally understood in Europe. Even Linné's name was Latinized , which explains why he is known to the world as Linnaeus. The merits of Linné's binomial system were quickly recognized, and it was accepted and followed by other scholars. Its use persisted without interruption until, by international agreement in 1867, the Linnean system became the standard for naming plants. Finally, in 1905, it was agreed internationally that the proper names of plants would be reckoned from the date of publication of Linné's *Species Plantarum* (1753). All plant names published before this date were rejected. Today, all names for newly discovered plants must be Latin in form and published with a description of the species in Latin.

The next time you encounter a Latin plant name, look at it, try to pronounce it. Sooner or later you may meet that name again, or possibly find yourself in a situation where you say: "I wish I could remember that name." Think of your personal pride when your neighbor stops by to watch you plant a new shrub, and in answer to his inevitable question, you can say: "It's a new variety of *Viburnum macrocephalum.*"

HOW NATURE PREPARES FOR WINTER

DR. F. W. WENT *looks behind the scenes of autumn color*

NATURE, in preparing herself for winter, seems to be guilty of enormous waste in the form of great masses of discarded leaves, the dying of the above-ground parts of perennials, and the wholesale death of annual plants. Yet this waste is inevitable since, in most plants, the leaves are so sensitive to adverse winter conditions that they could not survive. However, if we consider the autumnal leaf fall from all angles, it does not turn out to be so bad as it seems at first glance. It might even be said that it is a blessing in disguise.

An annual plant dies less than a year after it germinates, but only after it has finished its life cycle. After having produced seeds, through which the species can continue, it has fulfilled its mission, and even if by some chance the mother plant survived the winter, it would not produce more, or earlier, seed than seedlings germinating next spring. In these annuals, the effort to produce seed is usually so great that not only all food produced in previous months is used up, but also the substance of the stem and leaves is drained from them. Thus, they wither prior to complete seed maturity.

FOOD DRAINAGE

In the agave and yucca, you can observe clear examples of such complete drainage of all living substance from the leaves and trunk. While the plant is still flowering, the leaves start to shrivel, and this shriveling, which indicates progressive emptying of the leaf cells, continues until at seed maturity the rest of the plant is dead. All life has flowed towards the seed. A corn plant may also seem pretty dry after the seed has matured, yet the stalk and leaves still contain a lot of unused food. Dried corn stalks and leaves, therefore, make excellent cattle fodder, especially after silage.

In perennial plants and deciduous trees, the plant seldom (or never) flowers or fruits itself to death. The leaves usually stay on for some time after maturity of the fruit. This is essential for survival of the plant. The fruit production of a cherry, peach, or plum often takes most of the strength from the tree, and the spent storage food has to be replenished. This is accomplished during a few months of intensive photosynthesis after the fruit has become ripe.

FOOD STORAGE

But this is not all. Just prior to the turning of the color in leaves of deciduous trees, they start to mobilize their most important constituents. By the time the leaves drop, they are not much more than empty containers. Attached to the tree they were active factories, provided with all machinery necessary to produce food and other essential chemicals. They also had some storage space, where the manu-

factured products could be kept until they were transferred to more permanent storage. In autumn, the most valuable machinery, which could not easily be replaced, is moved out of the leaves to branches and trunk. It is then available when new factories have to be installed next spring, when new leaves develop. The most valuable parts are nitrogen-containing compounds (especially proteins), potassium, and phosphorus. These are moved out of the leaves, and this causes the well-known change in color. The green chlorophyll, containing nitrogen, is decomposed, so that only the yellow and orange carotenes are left, and the leaves turn yellow. The sugars and starch are moved out of the leaves. What is left are, mainly, the cellulose of the cell walls, some calcium, the yellow carotenes, and some other materials which are either too hard to move, or which are not very essential.

The dry leaves which drop off in the first autumn winds, after turning color, are really empty shells. This is also indicated by the fact that they decompose very slowly. If they were full of proteins and sugars, such as green leaves are, bacteria would feast upon them, and they would rot rapidly on the moist ground. Fresh leaves, such as grass clippings, put in a compost or leaf mold pile, disintegrate rapidly. But the dead autumn leaves take much longer to decompose. When they are mixed with fresh manure and other materials nutritious to bacteria, they rot more rapidly, but left to themselves, nothing much happens. They have become inert.

The removal of nitrogen, potassium, and phosphorus from older leaves also occurs in annual plants, but only when there is a deficiency of these nutrients in the soil. A plant starving for nitrogen will have its buds and young leaves grow at the expense of the nitrogen in the older leaves, which is moved out. This causes the older leaves to turn yellow and drop off. But in case of a calcium deficiency, the older leaves do not turn yellow and die, because calcium cannot be removed from the older leaves. This is also true in the autumn drop of leaves. They fall off still retaining their full content of calcium.

During the Indian summer in the east, but also to some extent during the fall in the west, leaves of sumac, Virginia creeper, and sweet gum turn a brilliant red or purple. This color is due to the formation of a pigment, anthocyanin, which usually is produced in cells full of sugar. The reddening of the leaves is an indication that their sugar content has gone up. This increase in sugar is usually due to transformation of starch into sugar. The insoluble starch cannot be moved as such. It first has to be changed to sugars which are easily soluble and can thus flow out of the leaves. Formation of sugar from starch occurs rapidly when the temperature drops to near freezing. Therefore, the red colors of the Indian summer flare up after the first cold nights. The cold is the signal, for trees and shrubs, that winter is approaching, warning them to start emptying their leaves before it becomes too cold. They rapidly dissolve their starch, and the resulting

high sugar content causes the formation of the red and purple anthocyanins.

COLORS

This effect of cold on red pigment formation explains why the red autumn colors in the Pacific Coast regions are seldom of the intensity encountered in the east. Plants here very seldom are exposed to near-freezing temperatures before they have lost their leaves. Autumn colors here are of the rich golden and yellow types, due to the loss of chlorophyll which normally masks the yellow carotenes.

This also teaches us a lesson about pruning the older leaves of a healthy plant. During the life span of a leaf, there first comes a period when it is growing rapidly and is using much more food than it can make. The second period is the longest. During that time, the leaf's chemical factory is working full blast, and it provides the rest of the plant with food and hormones. The last period sets in as the color begins to change. The factory is dismantled, storerooms are emptied, and all is moved toward the branch. The amount of food and material which becomes available in this way may equal weeks of activity of the leaf in its second period. Therefore, cutting leaves off just because their color is not lush green any more may deprive the plant of huge supplies just ready to be shipped. Usually the leaf drops off by itself at the proper time, through the aid of a very neat mechanism.

Where the leafstalk joins the stem or branch, there exists a layer of cells which are inactive so long as the leaf is active. The activity of the leaf is registered on these cells by the auxin, or plant-growth hormone, which is formed by the leaf. As soon as the flow of auxin stops, this layer of cells becomes active. The cells separate from each other, and in a few days, this layer has become so weak that the leaf, plus leafstalk, breaks off at a slight touch or a breath of wind. As a leaf grows older, it forms less and less auxin. A leaf, after turning yellow, produces no more auxin, and therefore the leaf drops a few days after it has changed color.

—Reprinted from *Sunset*
November, 1945

Review of

VEGETATIONAL HISTORY OF THE OZARK FOREST

by Julian A. Steyermark

Published by University of Missouri Press, Columbia, Mo., 1959

THIS long and scholarly article will be of interest to students of the flora of the Ozarks. However, one should not try to find too much general information, since the article is largely written as a refutation of the views of Beilmann and Brenner, which they published in the Annals of the Missouri Botanical Garden in September, 1951, Pages 261 to 291. There-

fore, Steyermark's chapter headed "Evaluation of Recent Works on Ozark Flora", should really read "Critique of the above-mentioned article by Beilmann and Brenner".

Science progresses through collection and intensive study of available facts and a critical interpretation of these facts. Very seldom can a particular view be considered definitive, but each new study is a further penetration, and presumably will correct previous interpretations of the available facts. In this way there is little doubt that Steyermark's book is a definite improvement on the earlier work of Beilmann and Brenner. The latter studied from the situation as existed in the St. Louis and Gray Summit area in the extreme northern part of the Ozarks, and came to the conclusion that most of this forest was of secondary nature. From this they generalized, and concluded that the forests of the Ozarks are of very recent origin.

Steyermark in his article shows this to be an incorrect generalization, and makes it abundantly clear that most of the Ozark region was covered with primary forest. His most interesting chapter is on the present distributional patterns of plants and their development. He makes it clear that a large number of typical Ozark plants are endemic there and must have evolved in that area, especially in the forests, such as: *Callirhoe involucrata, Castanea ozarkensis, Ruellia pedunculata* and *Gallium arkansanum.* Since all of these and many other local species occur in forests, they indicate the age of the forests in the Ozarks.

We might take issue with a statement on which Steyermark bases much of his argument: "The precise and definite relationship apparently existing between a species of restricted distribution and its environment usually indicates that there has been a fine adjustment between that species and its environment, one which has evidently required a long period of time for its adaptation to certain types of soils, temperature extremes, rainfall, and exposure."

We know of a large number of cases, where a species, now restricted to a very small area, has almost unlimited potentialities for growth under a wider range of conditions. Good examples are: the Monterey pine *(Pinus radiata)* occuring in nature in only very limited areas in California, but now very widely planted elsewhere in the world for timber; the dawn redwood *(Metasequoia glypitostroboides)* found growing wild in only a few provinces in China, but formerly distributed over much of the world, and still doing well, when planted in most of Europe and North America.

It also has been shown that many plant species have a most remarkable ability to adjust themselves to widely-varying climatic conditions by developing so-called "ecotypes." Therefore, one must be very careful in concluding that "such micro-climates or edaphic conditions, as they are judged to be, are the key to the diversity of the geographical distributional pattern within the Ozark Region; as they are indeed in other regions of the world, and help to explain many of the variations of the flora."

Most of the rest of Steyermark's study involves historical study and contains extensive records of early land surveys and a lengthy discussion of Beilmann's and Brenner's arguments.

—F. W. Went

JUNIOR RESEARCH TEAMS OF THE PITZMAN NATURE PROGRAM

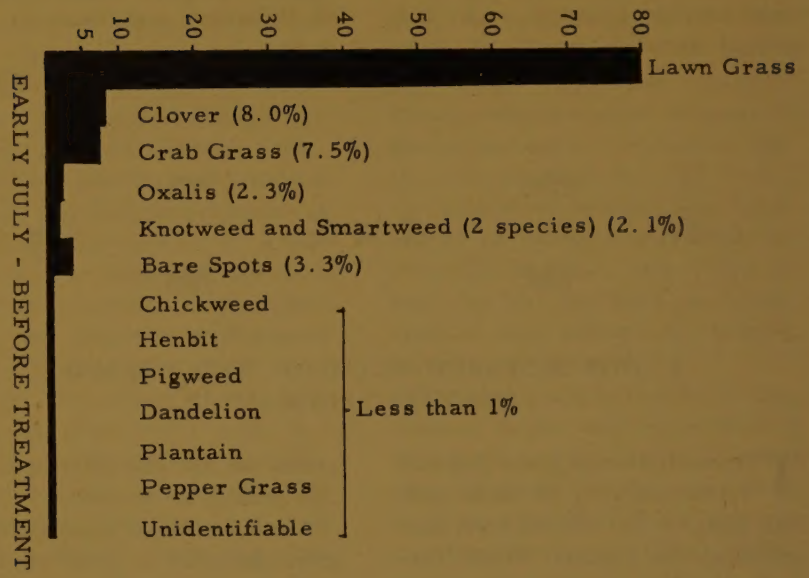
The newly formed Junior Research Teams consisting of senior children (ages 12–15) selected from each session of the Pitzman Nature Program have recently completed two projects of value to the Garden.

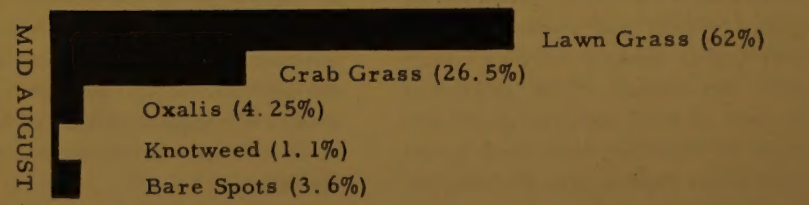
The first group, consisting of seven children, made a study of weeds in a lawn area at the Garden. They collected a large number of weeds, identifying, pressing and mounting them, each student making his own collection. An estimate of the percentage of cover of weed and grass species was made by throwing one yard square quadrats at random over the lawn before and after treatment with a weed killer. The results showed that, although many weeds were killed, application of weed killer for broad-leaf plants made during the hot summer months resulted in an increase of crab grass (see graphs). It was concluded that: (1) Crab grass, a fast grower in hot weather, fills in bare spots left by the death of weeds and (2) blue grass and other desirable cool weather lawn grasses are not able to compete with crab grass in hot weather.

The second team, consisting of five girls, conducted a survey of all the species of oak trees in the Garden. Each of the girls made a collection of oak leaves which she labeled and mounted. The team then plotted the positions of the oak trees area by area on small maps of the Garden. These areas and oak tree positions were then incorporated into a large map of the Garden for display purposes. This renders a complete picture of the 20 kinds of oaks to be found at the Garden.

These two projects were devised to stimulate a deeper interest and understanding of the more scientific aspects of nature study that cannot be accomplished with large groups of children. Displays of the work accomplished by the Junior Research Teams can now be seen in the information office at the Main Gate. These groups were supervised by Beth Andrews, Josephine Davies, and Kenneth Peck.

(See graph page 92)


EARLY JULY - BEFORE TREATMENT
13 Different Species Other Than
Lawn Grass
5
10
20
30
40
50
60
70
80
Lawn Grass
Clover (8.0%)
Crab Grass (7.5%)
Oxalis (2.3%)
Knotweed and Smartweed (2 species) (2.1%)
Bare Spots (3.3%)
Chickweed
Henbit
Pigweed
Dandelion
Plantain
Pepper Grass
Unidentifiable
Less than 1%


MID AUGUST - AFTER TREATMENT
With 2-4-D. Only 3 species of
Weeds Left
Lawn Grass (62%)
Crab Grass (26.5%)
Oxalis (4.25%)
Knotweed (1.1%)
Bare Spots (3.6%)

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SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission twenty-five cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Ave. gate, 2121 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., adjacent to State Highways 50 and 66. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.